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Tree planting for carbon mitigation? Assessment options over the life cycle

Niels Jungbluth, Nadia Malinverno, Martin Ulrich
ESU-services Ltd., Schaffhausen
www.esu-services.ch
jungbluth@esu-services.ch

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The promises:
Tree planting for CO_2-compensation

- Tree planting is an effective strategy for climate change mitigation, with considerable untapped potential
- Trees are a natural way of capturing a certain amount of carbon from the air during their lifetime
- Reforestation reduces the effects of flooding and erosion and enhances biodiversity, soil quality and social benefits
- A tree planting project is simultaneously a social project, since there is a collaboration with local partners

What do the organisations promise so far?

Examples of different organisations and their individual data:

- Treedom: 39kg CO_2 /tree/year
- Nature fund: 10kg CO_2 /tree/year and 500kg CO_2 /tree/lifetime of a tree
- Trees for All: 8-10t CO_2 /ha/year during growth
- Menschen für Menschen: 1 ton of CO_2 captured by plantation of 18 trees

- Until now: No consideration of risks and emissions caused during maintenance of the forest project.
- Lack of transparent calculation rules.

Key questions in this presentation

- What should a calculation for the CO_2 benefits of planting trees look like from an LCA point of view?
- What needs to be included?
- What is the base case for calculation?
- How is the time dimension included?
- How are future maintenance and risks included?

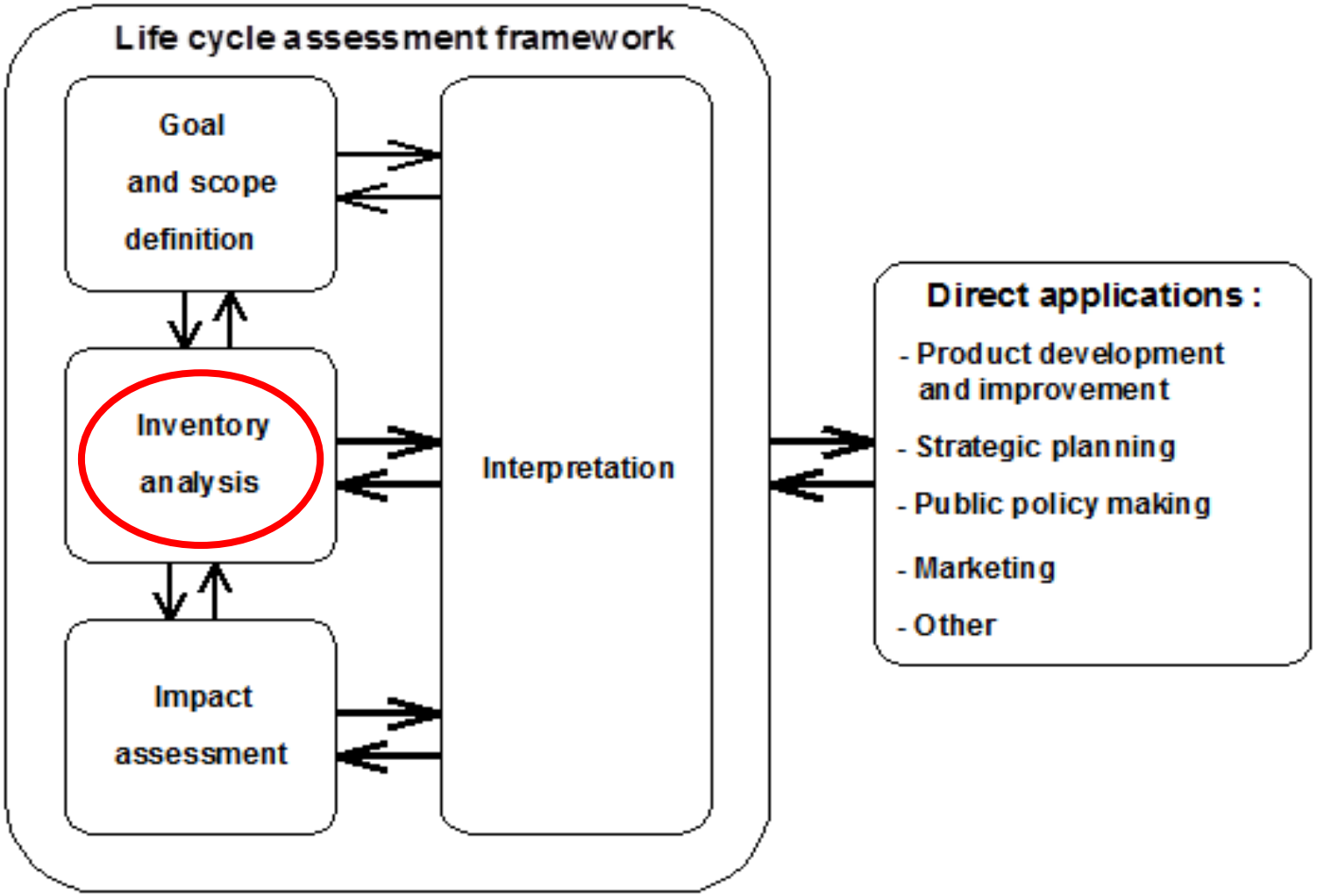
Concept for a true and fair calculation

- Setting a goal and the functional unit
- Baseline and future scenario definition
  - Tree type, project area, number of trees in a defined space
  - Type of forest definition (protected or managed forest)
- System Boundaries
  - Risk definition (e.g. windfall, forest fires, loss of the captured C)
  - Trees felled yearly for management or due to natural causes
  - Use of average numbers or on-site measurements
- Calculation of captured CO_2 per hectare in the last year (real time capturing) considering the whole carbon balance of the area (inclusion of soil carbon balance, wood, etc.), allocation per tree
- Inclusion of the emissions caused by seedling production and forest maintenance (depending on the type of forest)

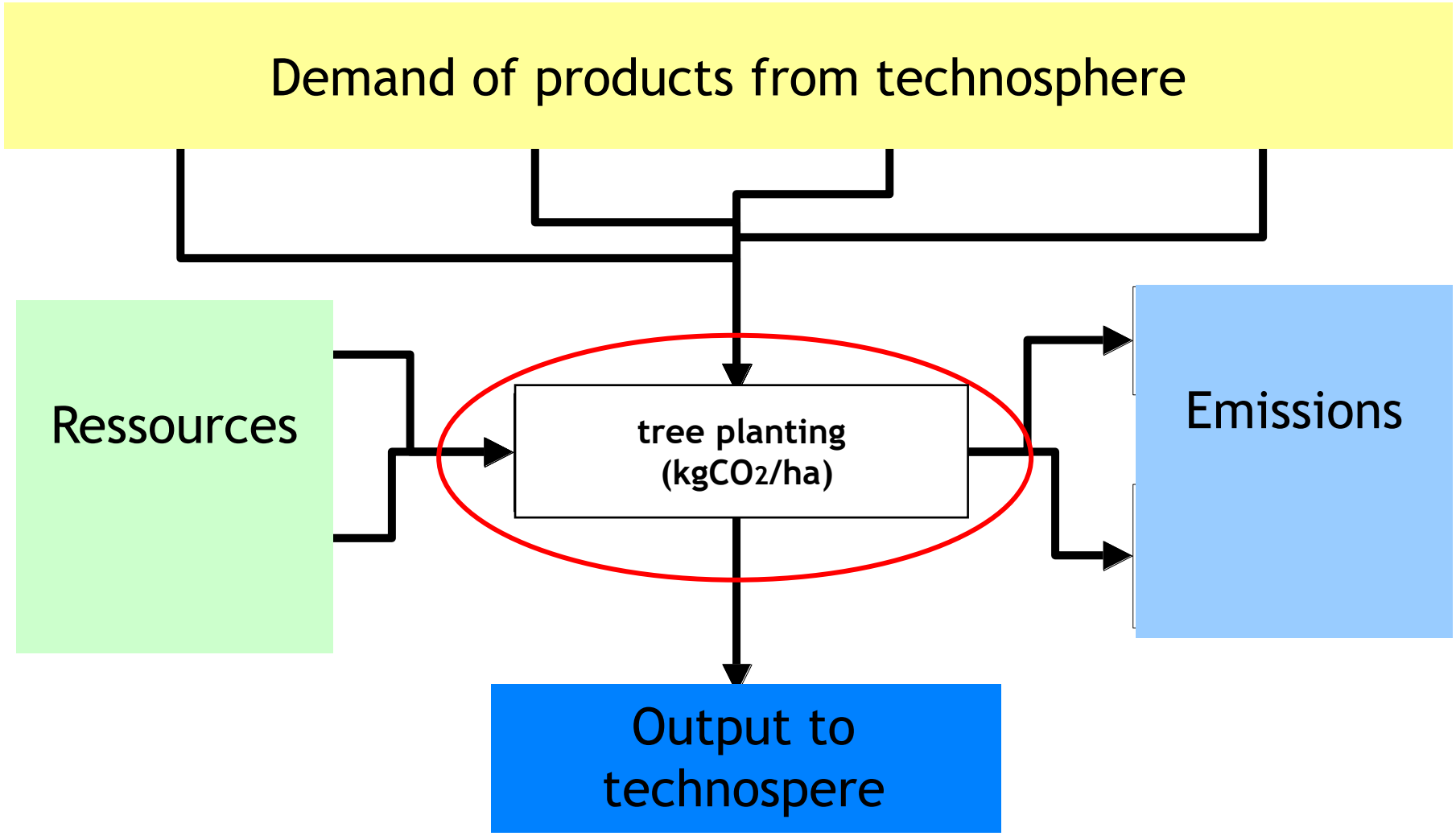
Possible problems

- Calculation of the captured CO_2 of the entire project area over the lifetime as a future projection is not suitable because of risks
- Tipping points of climate change are not avoided by future carbon capture
- If timber is sold, benefits must be shared between user and investor
- Calculation of the captured CO_2 per tree is a good communication tool but not practical (calculation per ha)
- Oversimplification: Only use of defined parameters for model calculations to reduce complexity

LCA according to the norm ISO-14040



System flow chart



- All inputs and outputs of the examined process are recorded

Calculation of the captured CO_2 by trees

The following data is needed:

- Functional unit: Carbon captured on the planted area in the year in question
- Use average values for specific type of tree and location or the reported data from on site measurements
- Consider dry matter and carbon content in the tree including roots and soil
  - *dry matter*carbon content*3.67= amount of CO_2 sequestered*

For the calculation of the captured CO_2 in the entire project:

- Functional unit: tCO_2 /ha
- Allocation with number of trees per hectare planted/standing

➢ Calculation needs to be done by forestry experts or based on literature research.

Calculation of the emissions caused by forest maintenance

Examples of issues that should be considered for the different steps during maintenance :

- Delivery: hand, different trucks
- Planting: hand, grinder, tractor
- Irrigation: tree bag, different trucks, tractor
- Pruning: chipper, chain saw, climb
- Removal: chain saw, bucket, loader, pick-up truck
- Disposal: landfill
- Managed forest fires

Other factors to be included

- Emission of greenhouse gases (methane, N_2O, CO_2) from soil
- Travel for verification (e.g. airplane trips)
- Reference scenario (what would happen if no trees are planted?)
- Risks of losing carbon storage in future

Timeline of emission reduction

- So far, initiatives claim CO_2 storage over the growing period
- CO_2 capture is low at the beginning and increases over the years
- Climate change has to be tackled today in order to avoid tipping points like melting of glaciers

➢ Future reduction of CO_2 in atmosphere cannot repair damage occurring today

Data collection in projects

- Data collection according to the parameters used in the model
- Reference state before project
- Type of trees or mangroves
- Data on maintenance of forest
- Number and change in numbers of trees standing compared to reference year

Conclusions

- Present claims for carbon mitigation with tree plantation do not follow any clear standards and lack transparency
- A life-cycle perspective is necessary for a realistic and fair assessment of the potential reduction of CO_2 emissions
- ESU-services can provide assistance for proper calculations of such emission reductions

Further conclusions

- To guarantee carbon storage into future, it seems more relevant to protect existing forests/soils and functioning ecosystems
- Tree planting not very effective (Coleman et al. 2021)
- Natural regrowth of forest is cheaper and shows higher potential in carbon storage than planting trees (Duguma et al. 2020; Lewis et al. 2019)
- Planting incentives must go along with “think global – act local” otherwise high failure potential (Fleischman et al. 2020)
- “Protecting land” with naturally (re)growing forest would be a more sustainable investment to sustainably capture carbon

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In case of any questions, please contact:

Dr. Niels Jungbluth, CEO - Chief Executive Officer
ESU-services Ltd. - fair consulting in sustainability
Rheinstrasse 20
CH-8200 Schaffhausen
www.esu-services.ch
tel +41 44 940 61 32
jungbluth@esu-services.ch